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Concrete

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New Methods Feature Construction of All-Concrete Museum

High-Frequency Vibrator Compacts Concrete—Dressed Lumber, Waste Molds for Ornamental Work and Metal Wall Cores Feature Form Work

By **HARLAN H. EDWARDS, C.E.**
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PROGRESS in the art of concrete construction is exemplified in the new developments featuring the construction of the Natural History Museum now being built in Balboa Park, San Diego, California. A new method of compacting concrete by means of internal vibration, special wooden pan forms developed by the contractor for concrete joist floors, hollow monolithic concrete walls and specially colored and finished concrete floors are among the progressive methods in use on this job.

An All-Concrete Building

The new Natural History Museum is designed as an all-concrete building, having exposed concrete walls both inside and outside. The building is planned to harmonize with the other neighboring buildings of Mediterranean type, which were of temporary construction, built in 1913 for the San Diego World's Fair. All ornamentation is cast-in-place concrete, requiring careful form construction, perfect placing of concrete and precise quality control.

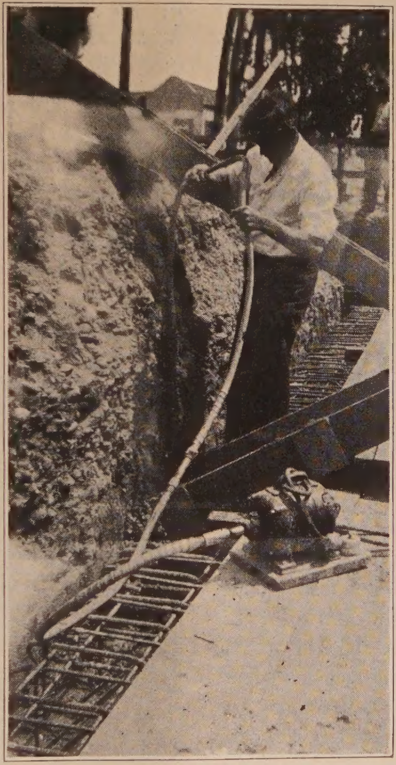


Figure 1. Use of internal vibrator on foundation concrete

The main building is 60 ft. wide by 220 ft. long and three stories in height, with a three-story wing, also 60 ft. wide by 100 ft. long. It was designed in four separate sections with cold joints between, yet tied together with heavy asphalted steel hooks to allow for shrinkage with the minimum of cracking. The job requires the placing of approximately 4,000 cu. yd. of concrete. The exterior walls are to be sprayed with a colored waterproofing material and the inside walls will be treated with a color coat of paint applied directly to the concrete. Because of the importance of securing the necessary density and appearance of the exposed concrete, particular care was exercised in the building of the forms and in the placing of the concrete.

Form Work at Low Cost

Forms were of 8-in. board, surfaced on all sides. They were placed tightly together so that practically no fins were left, on removal, and so that the joint marks of the wall form boards were visible around the entire building at exactly the same levels. It was intended to show the form marks both inside and out, yet have no joints which would cast a shadow. Column forms were lined with Presdwood and ornamentation was obtained by means of plaster waste molds erected in place so that the concrete for the walls, floors and ornamentation could be placed monolithically.

Pans used for the joist floor construction were developed by the Jarboe Construction Co., contractors. They were built with beveled wood sides so designed that the removal of a single wooden key strip permitted the removal of the pans without affecting the column or joist forms. Presdwood similar to that used in the columns was used for the top of the pans. The savings in labor resulting from the ease of erecting and stripping these special pan forms, together with the greater number of re-uses made possible, effected economies that resulted in an unusually low form cost.

Core Forms Produce Hollow Walls

Hollow monolithic concrete walls were built by the use of special steel core forms, manufactured and placed by the Monolithic Hollow Wall Co., of San Diego. These forms consist of adjustable sectional, steel core forms, set in place after the wooden outside forms are erected.

Steel T-bars are set in recesses left in the concrete at the proper intervals, which act as interior guides, holding the core forms in place. The core forms are slipped over these "T" guides and tightened by simply pressing a lever conveniently placed inside the core. After the concrete is placed the forms are collapsed by lifting this same lever, and are removed. The walls vary in total thickness from 20 in. to 35 in., in the center of which are the hollow cores described, providing outer concrete walls 8 in. thick and an 8-in. air space and 4-in. inner walls, or a variation of this dependent upon the total wall thickness. By this means the architect was able to obtain the deep window recesses desired without the use of solid concrete walls. This gave, also, the advantage of lighter weight, air-cell insulation and rigidity at low cost, and it materially simplified the form work since there were no projecting columns. Hence, there was much less waste of lumber than on other designs. The cores were placed and removed at night so as not to interfere with concrete placing.

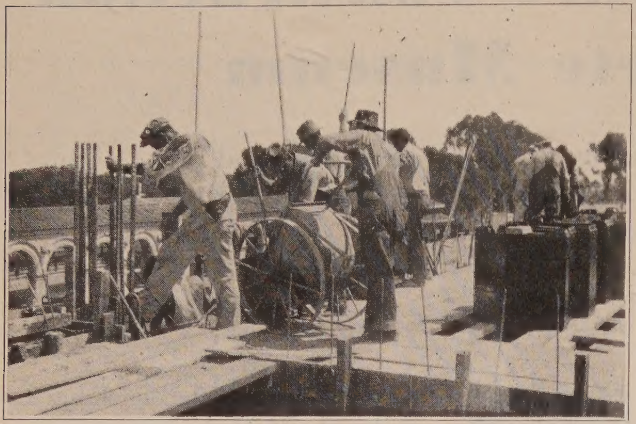


Figure 2. Distribution of concrete. Observe metal forms at right, used to produce hollow monolithic walls

Concrete Mixtures

Concrete was proportioned approximately 1:3:3½, these proportions having been varied slightly to insure the greatest workability and density. The coarse aggregate was crushed gravel having a maximum size of 1 in., and a fineness modulus of approximately 3.0. For the bulk of the work the combined fineness modulus averaged 5.63. All aggregate measurements were based on dry rodded volume and the sand was inundated. Slumps ranged from 4 in. to 7 in., dependent upon the character of form work encountered.

Concrete was mixed in one mixing plant, serving the entire job. Aggregates were delivered by truck and dumped into 25-yd. bins over the mixer. Rock was measured by volume, the sand in a Blaw-Knox inundator, and the measured materials were discharged into a 21-S Davies mixer equipped with a batch timer. Concrete was hoisted, chuted to a floor hopper and buggied to the forms. The wall of an entire section was placed in one concreting operation. This was followed by placing the floor, then the next wall, etc. Waste mold work was concreted slowly, working the sticky mass into all fine details by hand.

Concrete Placed by Internal Vibration

Because of the thin wall sections at each side of the hollow wall cores and the heavy reinforcing designed to resist earthquake shock, the problem of getting the concrete into the forms so as to obtain the density and appearance demanded for an exposed job, was of great importance. To produce the desired results, the concrete was compacted by means of the Viber electric tamper, manufactured by the Viber Company, of Los Angeles. This vibrator consists of a 1¾-in. tube, approximately 36 in. long, in which a shaft carrying an eccentric weight is caused to rotate by a 1/3-h.p. electric motor.

In operation, the shaft is inserted into the concrete at various places after deposition into the forms, the motor causing the shaft to vibrate at a rate of 5,000 vibrations per minute. This causes the concrete to flow and compact into the forms and around the reinforcing steel. The use of this compactor does not require special form construction, since compaction is secured by direct internal application to the concrete itself.

One man, operating the electric tamper, was able to compact the concrete as quickly as it was placed. When concrete was placed in wall forms, a flexible shaft vibrator was used, enabling wall heights up to 24 ft. to be placed in one operation. For compacting the concrete in the floors and beams a tamper operated by handles on the motor housing was used.

The structural slab floors were finished monolithically by Davis & Davis, of Los Angeles, using the methods developed by them to incorporate color into the surface. This color is troweled into the floor, after which it is finished in the regular manner. After finishing, the floor was covered with Sisalkraft paper over which a roofing felt was asphalt-mopped to prevent damage to the floor during construction.

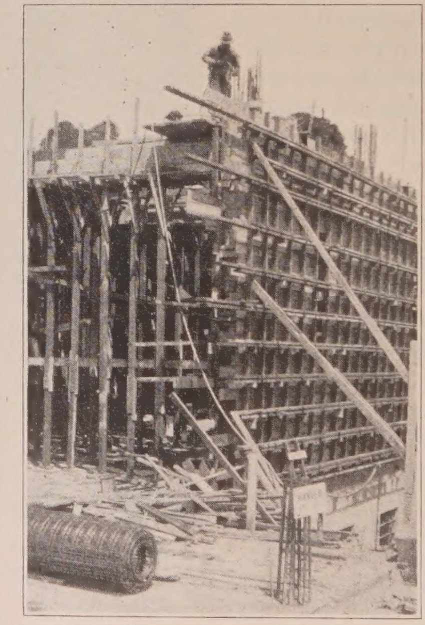


Figure 3. Placing concrete in wall in 24-ft. "lift." Man at top is operating vibrator

Personnel

The Natural History Museum is being built with funds obtained by public subscription. Wm. Templeton Johnson, of San Diego, who has designed notable buildings in the United States and Spain, is the architect. The Jarboe Construction Co., of San Diego, are the contractors. The writer, who is consulting engineer for Claremont, Scripps and Pomona Colleges at Claremont, Calif., is consulting engineer in charge of the concrete work. E. E. Anthony, of San Diego, represents the writer on the job and handled laboratory details of control on the job. Oliver G. Bowen, of Los Angeles, assisted by Stanley Burex, of San Diego, is structural engineer, co-operating with the architect in the structural design of the building. I. C. Curry is job superintendent for the contractor.

Precast Concrete Ramp Units Create Safe Walkway Surface

Wearing Qualities Proved by Eight Years of Service—Colored to Match General Scheme — Manufacturing Process Employs Vibration

A PRECAST concrete unit to serve as a wearing surface on ramps subjected to heavy foot traffic has been developed by the Chicago Art Marble Co., Chicago, Ill., and has been in successful use in locations such as the Chicago Union Station, built in 1924, and in the Daily News Building, completed in 1929.

At the time of the construction of the union station, the materials commonly specified as the wearing surface for ramps had not been entirely successful, in spite of the study given to the subject. As a result of conferences between the manufacturer and the architects and engineers representing the Union Station Company the ramp unit was developed.

Trial Service Leads to Adoption

Before the complete ramp was installed at the union station a sample specimen was placed and was tried out under continuous foot traffic for several hours daily. The sample surface was found to be successful in preventing slipping, and it withstood this wear admirably, as a result of which the remaining surface was placed.

Since the union station installation was placed, similar units have been laid on ramps in a number of important buildings, notably among them the Daily News Building, in Chicago. In this building the ramp leading to the second floor concourse carries the greater part of the foot traffic that enters and leaves the C. & N. W. railway station. As at the Chicago Union Station, the great volume of foot traffic arises from the suburban passenger business.

Description of Unit

As the drawing indicates, this unit has a maximum thickness of 1¼ in. and an average thickness of fully 1 in., and a width of 5 in. The length may vary, but those installed in the Daily News Building are 36 in. long. In cross-section the ramp unit is similar to a washboard on a large scale, the rib providing a positive grip for the foot of the pedestrian. Special abrasive materials are mixed with the concrete and colored stone aggregate to aid in the prevention of slipping. Each strip is adequately reinforced with steel rods.

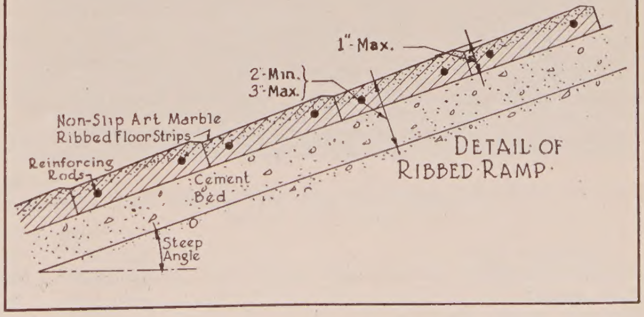
The ramp unit is laid in a bed of cement-and-sand mortar. The walkway is usually laid with a crown, and with gutters along the walls, so that when washed down the water can be carried off to drains.

Manufacturing Process Involves Vibration

In the manufacturing process these units are cast in molds under air compression and vibration. The unit is then passed through a series of operations, involving its curing, filling and finishing, after which it is ready for delivery and installation. The units are, of course, made in any color specified, so as to harmonize with the general color scheme.

Ramp in Daily News building, Chicago, showing concrete units used as the wearing surface in good condition after three years of service under heavy foot traffic

The manufacture and the use of these units in ramp construction are protected by patents. The unit is a high-class concrete specialty, and the manner of its development may well serve as an inspiration to other manufacturers.



Details of ramp unit of cast concrete

What Kind of Street Pavements Do Cities Prefer?

Survey of U. S. Bureau of Mines Shows Trend Toward Concrete in City Paving Types—The Causes Analyzed

By E. M. FLEMING
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SINCE no public agency has ever compiled statistics on city paving, the U. S. Bureau of Mines undertook such a survey* to furnish a statistical basis for estimating trends in the construction of street pavements. The survey was conducted in 201 municipalities having populations exceeding 40,000. These cities were distributed over 46 states and the District of Columbia.

Survey Covers 5-Year Period

The information collected covered the yardage of all types of pavement placed in these cities in the 5-year period from 1925 to 1929, inclusive. The types of pavement were classed as portland cement concrete; the block types, such as brick and stone; and the bituminous types, such as sheet asphalt, asphaltic concrete and macadam, tar macadam, asphalt block, natural rock asphalt and all other asphaltic types, which were grouped together. The yardage of pavement built not only covered new work, but resurfacing work as well, and excluded patching, repair and maintenance work.

The peak of annual street paving was reached in 1927 in the cities covered by the survey, when a total of 57,944,251 sq. yd. were constructed or resurfaced. The yardage built in 1929 decreased to 48,868,036 sq. yd., and it is known that further decreases in total paving occurred in 1930 and 1931.

Paving Trends in 201 Cities

The types of paving used in city work are usually identified as bituminous, block or portland cement concrete. The data contained in the investigation have been summarized in this matter in tabular form to show the trends

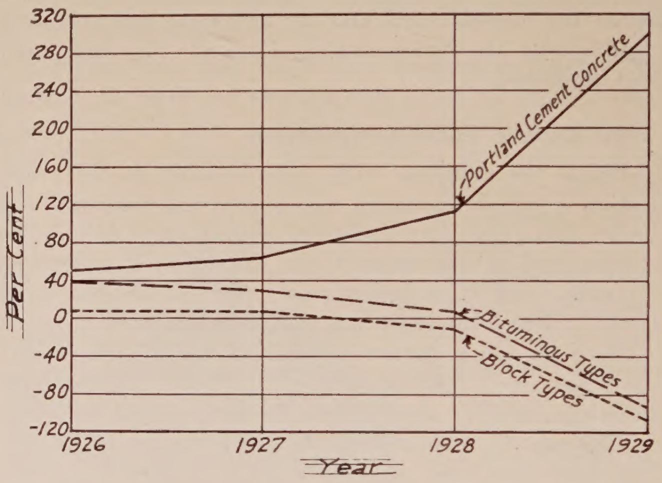

Figure 1. Percentage comparison with year 1925, made by each type of street paving in four years following 1925

STREET PAVING IN REPRESENTATIVE AMERICAN CITIES, 1925-1929
(Including reconstruction by resurfacing)
Department of Commerce, Bureau of Mines, Information Circular No. 6431
Yardage Figures from Circular, Percentages Calculated

TABLE NO. 1
Percentage of 1925 Yardage of Each Type of Pavement Placed in Four Succeeding Years

	1925		1926		1927		1928		1929	
Pavement Type	Sq. Yd.	%	Sq. Yd.	%	Sq. Yd.	%	Sq. Yd.	%	Sq. Yd.	%
Bituminous types†	33,152,351	100.0	36,515,587	110.1	36,332,021	109.6	33,193,626	100.1	31,677,936	95.5
Block types‡	5,084,180	100.0	5,615,322	110.4	5,703,273	112.1	4,412,155	86.8	3,413,019	67.2
Portland cement concrete	9,050,054	100.0	11,407,851	126.1	15,908,957	175.8	15,889,144	175.6	13,777,081	152.2
All types	47,286,585	100.0	53,538,760	113.2	57,944,251	122.2	53,494,925	115.1	48,868,036	103.6

TABLE NO. 2
Yardage Gain and Percentage of Total Yardage Gain Made by Each Type Paving Each Year Over 1925

	1926		1927		1928		1929	
Pavement Type	Sq. Yd.	%	Sq. Yd.	%	Sq. Yd.	%	Sq. Yd.	%
Bituminous types†	3,363,236	53.8	3,179,670	29.8	51,275	0.6	1,474,415*	—93.4
Block types‡	531,142	8.5	619,093	5.8	672,025*	—10.8	1,671,161*	—105.6
Portland cement concrete	2,357,797	37.7	6,858,903	64.4	6,839,090	110.2	4,727,027	299.0
Total gain	6,252,175	100.0	10,657,666	100.0	6,208,340	100.0	1,581,451	100.0

*Loss over 1925.

†Sheet asphalt, asphaltic concrete, asphaltic macadam, asphalt block, native rock asphalt and miscellaneous bituminous types of surfacing, including surface treatments.

‡Brick, wood block and stone block.

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*Street Paving in Representative American Cities, Information Circular No. 6431, Department of Commerce, U. S. Bureau of Mines.

in paving that exist in the 201 cities covered by the survey. In Table 1 the yardage of each of the three types of pavement constructed in 1925-1929 are given and the per cent increase for each year over 1925 has been computed. This table shows that the yardage of bituminous types increased to a peak in 1927, when 36,322,021 sq. yd. were built, or 109.6 per cent of the 1925 yardage. A decrease then started, and in 1929 less pavement was built than in 1925, the total for 1929 having been 31,677,936 sq. yd., or 95.5 per cent of the 1925 yardage. Sheet asphalt pavements made up about 60 per cent of the total bituminous yardage. The block types likewise increased in 1926 and 1927, and the total yardage built in 1927 was 112.1 per cent of the 1925 yardage. These types then fell off rapidly in 1928 and 1929, and in the latter year the total yardage placed was only 67.2 per cent of the 1925 yardage.

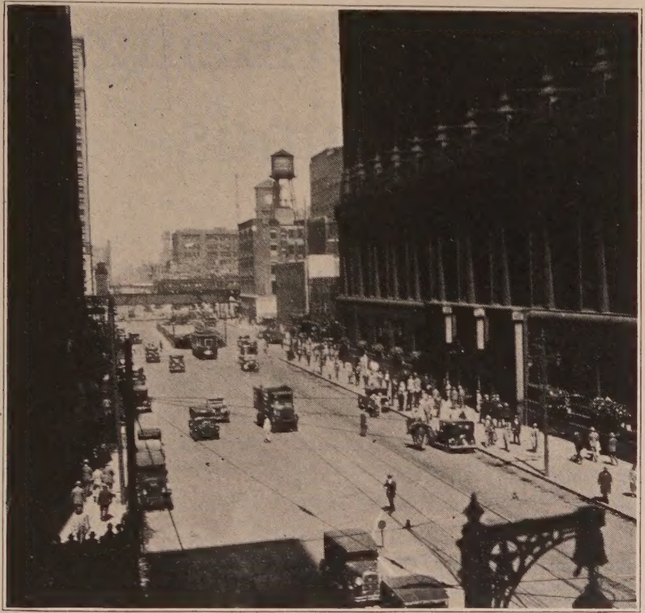
Figure 2. La Salle Street, in Chicago's loop, is paved with concrete

Gains in Percentage

The yardage of concrete pavement placed each year shows a characteristic or trend differing from the other types. The most yardage was placed in 1927, the same trend as shown by the other types; but the yardage placed in 1928 was almost equal and the recession in 1929 was so small that the yardage constructed was still 152.2 per cent more than the yardage placed in 1925. This not only overcame the decreases in the other types of paving but also resulted in a net gain of 3.6 per cent in total paving in 1929 as compared with 1925. The characteristics of the trend in concrete paving also vary from the other types in that the year of peak construction, 1927, showed a gain of 75.8 per cent over the 1925 construction, a percentage gain more than 5 times greater than shown by the block types and 7½ times greater than shown by the bituminous types.

Gains in Actual Yardage

The preceding discussion does not make any comparisons between the actual yardage gain or loss for each type of pavement during the period covered by the study. Accordingly, Table No. 2 has been assembled to show the yardage gain for each type for each year over the 1925 yardage. The per cent gain has also been computed for each year and is shown in the chart in Figure 1. Portland cement concrete pavements show a gain of 4,727,027 sq. yd. in 1929 over 1925, or 299.0 per cent of the 1925 yardage. Net losses of 1,474,415 sq. yd. are represented by the bituminous types and 1,671,161 sq. yd. by the block types.

Strong Trend Toward Concrete Streets

It is obvious from this survey that there is a very strong trend toward the use of more and more concrete for street paving in those cities. While the bituminous types represented 70 per cent of the total paving in 1925, in 1929 they accounted for less than 65 per cent of the total paving and show a loss of almost 1,500,00 sq. yd. from 1925 construction. The yardage of sheet asphalt streets, including resurfacing, and the yardage of portland cement concrete were about equal in 1929.

The yardage of concrete pavements placed in the cities covered by the survey increased more than 50 per cent during the 5-year period. During this same period, the concrete streets built in all cities increased more than 20 per cent. In the larger cities, a custom of usage exists that dates from before the advent of concrete street construction. As a result, these cities have been slow to accept what to them was the newer type of street pavements. The smaller cities, without this custom, have been using concrete street construction for many years. The larger relative increase in the larger cities therefore indicates that these cities, too, have learned the value of concrete streets and are building an increasing yardage each year.

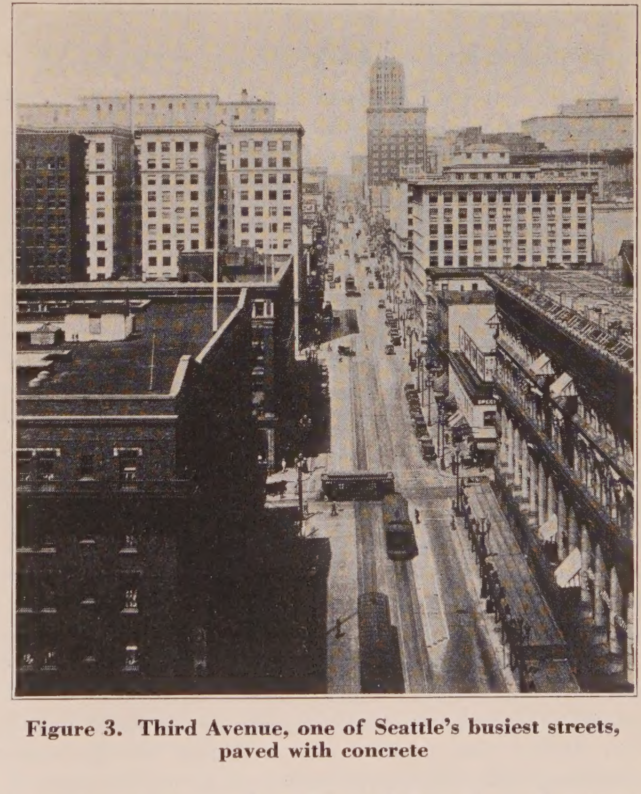
Figure 3. Third Avenue, one of Seattle's busiest streets, paved with concrete

Forty Years of Experience

The history of concrete street construction in the United States dates from 1892 and 1893, forty years ago, when the city of Bellefontaine, Ohio, paved the four streets around the court house. This street work, still giving satisfactory service, was the mecca for street engineers for years. It has been the nucleus for concrete street construction that now totals the equivalent of 24,000 miles of 30-ft. pavement.

Almost all the work on Bellefontaine's first concrete pavement was done by hand labor.

The trend in the increased use of concrete for street work since Bellefontaine made the start is the result of many factors, such as low maintenance costs, high visibility, smoothness, and a surface that gives sure traction even in wet weather.

Urge Prompt Action in Utilizing R. F. C. Construction Funds

Immediate Filing of Applications for Loans Will Mean Early Benefits—Million Men to Get Work

COMMUNITIES throughout the country may reap a double benefit from the new federal Emergency Relief and Construction Act which makes possible the expenditure of $2,122,000,000 for construction and for relief and relief work. The community will gain because of the opportunities for employment which the act provides through its construction features; and the public will be benefited by improvements that will remain to serve the community long after the present emergency is over.

Put a Million Men to Work

Passage of the law has been called the most momentous act of legislation of the present era. It possesses the power to bring about a revival of employment and immediately to stimulate construction. It is estimated that effective operation of the Act will put at least a million men to work. Out of the total appropriation, close to $2,000,000,000 is potentially available for necessary construction of one type or another. Much of this construction can be started almost immediately and is in addition to the other opportunities in the building field that will develop later as a result of the new federal Home Loan Bank Law.

Of the amount authorized by the Act, $322,000,000 is available for emergency construction of federal public works, including $120,000,000 for the federal highway system; $1,500,000,000 for self-liquidating projects, including bridges, tunnels, docks, viaducts, waterworks, canals and markets devoted to public use, housing for families of low income and reconstruction of slum areas; and $300,000,000 for relief and relief work.

Much of the latter amount, designated for relief and relief work, also can be invested in necessary construction if prompt and energetic action is taken to influence it that way. Such a plan would confer a double benefit on the community adopting it. Inasmuch as about 90 cents of every construction dollar ultimately goes to labor, use of relief funds for this purpose would furnish the community with improvements that are needed and also provide work for the unemployed. This plan would give employment, rather than a dole, to men out of work. It would avoid many of the undesirable results that follow operation of a dole system.

The question of the nature of public and semi-public work that may be classed as self-liquidating is answered partly by the Relief Act itself. Projects about which there is doubt must be decided on their merits by the directors of the Reconstruction Finance Corporation. It is to be hoped that the R. F. C. will soon issue a general policy that will clear up some of the questions that already have arisen; but the men who are charged with the duty of pushing the application for a loan to finance a worthy local project should not wait for a decision on R. F. C. policy. They should get the application into the proper hands at the earliest possible date and argue the legal points later.

Wayne County Scraps Doles and Gives Jobs

The value of the policy of using relief funds to provide employment is illustrated by the experience of Wayne County (Detroit), Mich., where the Board of County Road Commissioners decided that it was preferable to give jobs rather than doles to unemployed men. Since last October, 4,600 fathers who formerly drew $12 weekly from the county welfare department have been paid $1,842,000 for labor on concrete highways, bridges, grade separations, parkways and a two-mile seawall in the Detroit area. In 39 weeks, to July 1, the dole would have given each man $468. The average wage on the employment plan for the same period was $800. Funds raised by a half-mill tax cost taxpayers little more than if the dole had been continued.

Commenting on this, Edward N. Hines, chairman of the Wayne County Highway Commission, says: "The burden has been so small that probably few persons have noticed it. Men have been given work and the community has benefited. These roads and bridges will be with us when the depression has long been forgotten."

Initiative and Speed Are Imperative

While similar desirable results are possible under the new federal act, they will not be achieved unless local governments use speed in making necessary loans from the federal agencies and in initiating construction projects authorized by the law. Amounts available for federal aid highways can only be used on construction completed before July 1, 1933. Loans available for relief and relief work must be made within two years. Loans for self-liquidating projects must be made before January 23, 1934.

First Come, First Served

As thousands of applications for such loans will be made by local governments throughout the country, and as the money available is limited, those that get their applications in at once are more likely to obtain the funds desired. A number of applications already have been made, as shown by the following typical examples:

Wilmette, Ill., has applied for $600,000 to construct waterworks;

Toledo, Ohio, will apply for $15,000,000 to construct a water supply system and other improvements;

Wellsville, N. Y., is endeavoring to obtain $478,000 for a sewer system;

Mississippi will use federal credit to launch a $4,000,000 road construction program;

California has applied for loans to help finance two bridge projects costing many millions.

Many other sections plan to take advantage of the new federal law in obtaining funds for necessary construction. To help local governments to act speedily and thus secure the maximum benefit from the new law, it is necessary for everyone to exert prompt and vigorous influence to get loans made and work started.

With the double purpose of providing employment for those out of work and of securing public improvements which the community needs, but which lately it has not seemed practicable to build, it is urged that every public minded citizen and every business and civic organization join at once with local public officials in helping to obtain the necessary federal loans and in getting needed construction projects under way.

To Combat Unemployment Among Technically Trained Men

A technical service committee has been organized by the Engineers' Club of Philadelphia for the purpose of aiding unemployed engineers. An appeal is being addressed to employers, urging them to engage their technical staffs now, in order that they may "create and develop the better business of tomorrow." The appeal to employers follows:

The Philadelphia Technical Service Committee, specializing in engineering personnel, invites inquiries from employers seeking the services of engineers who can today create and develop the better business of tomorrow.

Many of these men were recently the key men in their particular lines of endeavor, and will be eagerly sought after when the wheels of industry again turn more swiftly.

They can today be made a part of your organization at a substantial discount from their cost of yesterday, to be your permanent employees of tomorrow.

Your selection is made from over nine hundred (900) registrants who have filed their record of education and experience with this committee, a group of technically trained men, able and willing to serve either as assistants, or in more responsible positions.

Make the most of this opportunity, send in your requirements to the P. T. S. C. located at the Engineers' Club of Philadelphia, 1317 Spruce St., or telephone PENnypacker 5234. The committee has the co-operation of the local sections of the 12 national engineering societies, and is associated with the State Employment Commission of Pennsylvania.

The personnel of this committee is composed of volunteers from among the unemployed engineers who give of their time and effort without recompense.

Board of Six Engineers Named to Aid R. F. C.

President Hoover has named a Board of Engineers to pass upon the engineering phases of construction projects on which the Reconstruction Finance Corporation has received applications for loans. The personnel of this board, selected partly with the view of spreading the membership over the major geographical divisions of the United States, includes Charles D. Marx (chairman), professor emeritus of civil engineering, Leland Stanford University; John F. Coleman, consulting engineer, New Orleans, La.; John Lyle Harrington, member of the consulting engineering firm of Harrington & Cortelyou, Kansas City, Mo.; Herbert G. Moulton, consulting engineer, New York City; John H. Gregory, consulting engineer, Baltimore, Md.; and Major General Lytle Brown, Chief of Engineers, U. S. Army, Washington, D. C.

The chairman of the board was President Hoover's own selection. The other members were selected from a list submitted by the American Engineering Council.

Highway and Building Congress Purpose and Plans

The Highway and Building Congress will be held in Detroit during the week of January 16 to 23, 1933. This was the decision of officials of ten national organizations, representing every phase of the highway and construction industry, who recently met in Detroit to formulate plans.

The program mapped by executives calls for concurrent meetings of the several individual organizations during the first three days of the Congress, to be followed by a joint session which will map a co-ordinated procedure for the entire industry and allied enterprises.

An exhibition of highway and building materials and equipment will be held simultaneously at the Detroit Municipal airport.

One of the basic undertakings of the Congress will be a program of education designed to acquaint the public with the contribution of the construction industry to sustained national economic equilibrium. It will define the place of highway and other forms of construction in respect to improved transportation, industrial and agricultural production and distribution, and all other phases of national life.

Participating organizations include: Construction League of the United States, American Road Builders' Association, Associated General Contractors of America, Motor Truck Executives Association, Asphalt Institute, National Crushed Stone Association, National Paving Brick Association, National Ready Mixed Concrete Association, National Sand and Gravel Association, and Portland Cement Association.

Low Cost of Form Construction on Pacific Coast

Re-Use of Low-Priced Lumber Not Important—Material and Labor Costs—Shores, Clamps and Other Accessories Rented

By C. H. WEITZ, C.E.
Oakland, Calif.

RECENTLY the writer obtained a reprint of the articles by A. B. MacMillan on "How to Save in Concrete Form Work," originally published in CONCRETE throughout 1930. The methods shown are admirable, so far as excellence of engineering and results are concerned; but here on the Pacific Coast we get lower labor costs than indicated in Chapter 12 of the MacMillan reprint, and our material costs are low because of the lower price of form lumber in this section.

Here on the Coast a large surplus of No. 3 Douglas fir is produced and placed on the market at prices ranging from $10 to $15 per thousand delivered, and this has undoubtedly influenced our methods of form construction, inasmuch as the saving of lumber by re-use is of minor consideration. In consequence, less care is needed in the removal of forms, and this part of the work proceeds more rapidly than in sections where the salvage of lumber must be kept in mind.

Form Construction Methods

The lumber is usually delivered quite green and is subject to considerable shrinkage. To keep the cracks between boards small, 1-by-6's are used in preference to 1-by-8's. The only 2-in. lumber used is for beam soffits, studs, joists and some cleats. All sheathing for floor slabs, walls, beam sides and columns is 1-by-6 S1S1E or shiplap.

LABOR COST PER SQUARE FOOT OF CONTACT SURFACE

Form Work Item	Labor Cost per Sq. Ft.
Wall footings, 1 ft. high	10.0c
Wall footings, 2 ft. high	7.0c
Stepped column footings	10.6c
Sloped column footings	12.5c
Foundation wall 7 ft. 6 in. high, no openings or pilasters	5.0c
16 ft. by 16 ft. by 11 ft. 7 in. square column	3.5c
30 ft. by 30 ft. by 11 ft. 7 in. square column	6.4c
30 in. octagonal column	9.8c
30 in. round column	12.0c
Wall column or pilaster, sides only (face included with wall area), 12 in. projection	16.0c
20 in. girder sides, 20 by 20 ft. panel	11.2c
14 in. girder sides, 20 by 20 ft. panel	14.5c
Beam and girder slab form, 20 by 20 ft. panel, including beam and girder soffits and shores, 12 ft. story height	6.4c
Flat slab form 20 by 20 ft. panel, including drop panel and shores, 12 ft. story height	7.4c
Floor slab, steel frame construction, including beam and girder soffits and shores, 20 by 20 ft. panel, 12 ft. story height	6.4c
Wall above grade, 12 ft. story, no openings or pilaster	4.8c
Concrete stair and platform	13.0c

NOTE: To the square foot costs for column forms of the particular size mentioned should be added 10c per lin. ft. for clamping square columns and 20c per lin. ft. for clamping octagonal or round columns. These linear foot costs include the rental of the clamps. The local costs of wall footing forms include the cost of batter boards, laying out and setting grades.

We find it cheaper to rent adjustable shores than to make jack frames. It is also cheaper to rent steel column clamps than to make them of 3-by-4's and rods.

There are several types of metal spreaders and wall ties of more or less merit on the local market, but for ordinary wall forms annealed wire and wooden spreaders are still used on many jobs. The objections to these special ties are their high cost in comparison with wire, the heavy investment in fittings, and unfamiliarity of the workmen.

With this brief description of our methods, the accompanying table is presented as a fair average of form labor costs on the Pacific Coast.

Our material cost for lumber, nails, wire and other accessories, after deducting salvage, is from 2½ to 3 cents per sq. ft. of contact surface.

The labor costs in the table are based on carpenters' wages at 90 cents and laborers' wages at 50 cents per hour.

In the actual estimating of form work the writer does not make so many separate items, as he uses the surface-intersection method of arriving at the quantities, which gives him only two main items to price.

A. R. B. A. Begins Campaign to "Sell" Road Maintenance

A Maintain-Our-Roads campaign has been launched by the American Road Builders' Association under the direction of C. N. Conner, engineer-executive of the association.

The campaign includes conferences and public addresses before meetings of road builders and national and civic organizations for the purpose of providing them with information to present to the public. Full newspaper and magazine co-operation is assured.

Coming Conventions

October 3-7—National Safety Council, twenty-first annual congress. Washington, D. C.

January 16-23—Highway and Building Congress. First annual meeting. Detroit, Mich.

February 20-23, 1933—American Concrete Institute, twenty-ninth annual convention. Chicago, Ill.

Light-Weight Aggregates Available Over Wide Area

Location of Producing Plants—Suitable for Structural Concrete and for Building Units—Processed Slag Aggregates Among Late Developments

MUCH has been accomplished in the past two or three years toward the perfection of the older types of manufactured light-weight aggregates for concrete and concrete products, and toward the development of new products of this kind. It will, therefore, be to the interest of all users of concrete as well as manufacturers of concrete products to keep informed on the character and sources of these light-weight materials.

Cinders as Aggregate

Readers of Concrete are familiar with the use of cinders in concrete and in concrete units. Many manufacturers of cinder concrete units use run-of-boiler cinders, depending on the selection of a specific source of supply to obtain a suitable material. Others employ cinders that have been processed in some manner, or at least washed and screened. In most cases the cinders are taken from sources where high-pressure steam boilers are used, the purpose being to get cinders that are well burned and contain the lowest practicable amount of ashes.

An important advance in the use of cinders in concrete work was made when the Underwriters' Laboratories established new standard requirements for commercial cinders.* In this new standard the allowable combustible content was increased to 35 per cent, by weight, whereas the former maximum was 20 per cent. This change increased greatly the number of sources from which approved cinders may be obtained.

Burned Shale or Clay Aggregates

Haydite, the well known light-weight aggregate manufactured from clay or shale of the kind used in making clay brick of good quality, is being produced in various plants operated by members of the Haydite Manufacturers' Association, of Kansas City. Plants are in operation at Kansas City, at Haydite, Ill., near East St. Louis; at Danville, Ill.; at Cleveland, Ohio; at Pittsburgh, Pa.; at Buffalo, N. Y., at Cookesville, Ontario, near Toronto, and at San Francisco, Calif.

Haydite is burned to a clinker in a rotary kiln, after which the clinker is crushed and screened into fine and coarse sizes. Methods have recently been improved, with corresponding improvements in quality.

Cel Sealed Aggregate is the trade name of another burned clay product which was put on the market on the Pacific Coast early in 1932. This product, made in rounded particles of various controlled sizes, is produced by the W. F. MacGlashan Associates at Alhambra, Calif., near Los Angeles. Briefly, the manufacturing process consists of pugging ordinary brick clay through dies and cutting it into lengths approximately equal to the diameter. These pellets are then coated with a refractory material, rounded by rolling in ball-rolling machines, and burned in a rotary kiln. During the heat treatment in the kiln the pellets expand and the refractory material forms an impervious coating on the surface of each particle.

Other burned clay aggregates are under development in the east and on the Pacific Coast.

Processed Slag Aggregate

Several light-weight aggregates falling under the general classification of processed slag are under production at steel centers, where blast-furnace slag can be obtained.

A well known product of this type is Pottsco, which is produced by the H. H. Potts Company, of Chicago, at a plant at Indiana Harbor, Ind., an industrial suburb of Chicago. This material is specially processed through the regulation of water temperatures. It differs from ordinary water-cooled slag by reason of this process, which produces a material that is hard and reticulated. Recent improvements in the processing method have resulted in increasing the strength of this material.

Another processed slag aggregate, known as Waylite, is being produced by the Chicago Waylite Aggregate Co. at a plant in South Chicago, Ill. Production was started in May, 1932. In this manufacturing process the molten slag comes direct from the furnaces into a centrifuge where it is treated in an atmosphere of steam, causing it to expand and thereby creating a material of light weight, impregnated with non-communicating cells.

Still another light-weight slag aggregate is produced at St. Louis, Mo., under the trade name of Cellastone, by the General Aggregate Corp., of that city; and a fourth slag aggregate, developed by the Victor Chemical Works, of Chicago, is about to start commercial production under the trade name of Tuff-lite, in a plant at Nashville, Tenn.

Suitable for Structural Concrete

With the possible exception of some untreated cinders, the aggregates here described are suitable for use in reinforced concrete work as well as for the manufacture of concrete building units.

High Building Costs Condemned in Housing Conference Report

Declaring that the American public pays too much for housing that is poor in design, construction, and equipment, a group of nationally known architects, builders, dealers in building materials and equipment, engineers, and home economists offer detailed plans for the correction of this situation in the fifth volume of the final reports of the President's Conference on Home Building and Home Ownership. The recommendations of these building authorities form part of the complete program to raise the standard of American housing that was formulated by the President's Conference at its meeting in Washington last December.

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*See July (1930) issue of Concrete, page 42.

Economize by Replacing Brick Walls with Reinforced Concrete

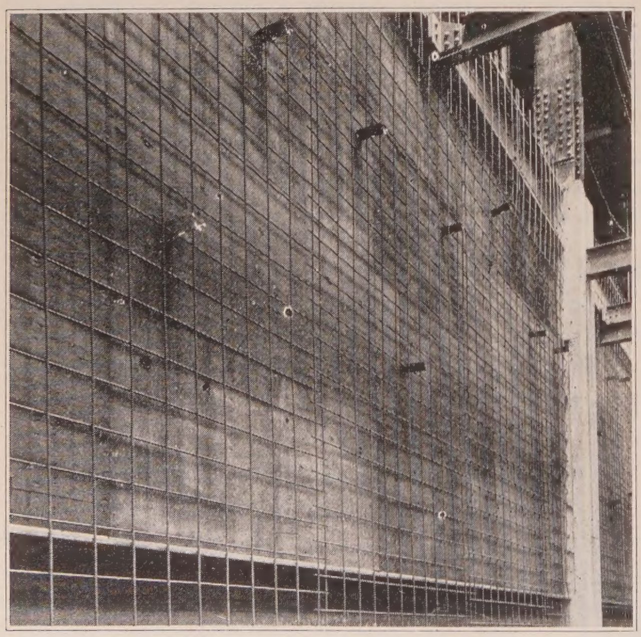
Interior Curtain Walls in Chicago Post Office Reinforced with Wire Fabric—Plywood Form Material Eliminates Plaster

THE original plans for the Chicago post office building, now under construction, included a number of 12-in. interior curtain walls of brick, intended to serve as fire-stops but to carry no load except their own weight.

Large Saving with Concrete Walls

Later estimates disclosed that these walls could be built of 6-in. and 8-in. reinforced concrete at a substantial saving in cost. Inasmuch as the total wall area involved amounted to about a quarter million square feet, the saving ran into large figures.

The illustration shows one side of the form work for a 6-in. wall in place, and the wire fabric reinforcement in place. This reinforcement consists of a heavy welded wire fabric with 6-in. meshes. In the 6-in. walls a single layer of the fabric, having No. 0 gauge wires spaced 6 in. center to center, was employed. This is the reinforcement shown in the illustration. In the 8-in. walls two layers of the fabric were placed, having No. 0 gauge wire spaced 9 inches center to center.



Interior walls of 6-in. and 8-in. concrete reinforced with wire fabric replace brick walls in Chicago post office

The anchorage of the reinforcement is also shown in the picture. This consists of short strips of sheet metal which were tacked against the side of the forms. The projecting end of each strip was bent back a short distance, a slot having previously been cut at the point of the bend. One edge of the slot was not cut, so that the small strip represented by the slot remained in place, still engaged at one end. This small strip was then pulled away from the main strip of metal, and the mesh was set in place, after which the small strip was bent around the wire that was in contact with it.

The steel reinforcement used in this extensive wall construction is an electrically welded wire fabric, made of cold-drawn steel, and produced by the American Steel & Wire Company.

Plywood Forms Eliminate Plastering

Large sheets of specially treated plywood panels, supplied by the Oregon-Washington Plywood Company, of Tacoma, Wash., were used in the form work for these walls. These plywood sheets, which are sold under the trade name of "Lock-tite," were supplied in various sizes but generally measuring 3 by 8 ft. They are made of 5 plies of Douglas fir that are cemented together with water-resisting glue under hydraulic pressure. By reversing the direction of the grain of alternate plies, any tendency toward splitting or warping is eliminated. The plywood used in these wall forms is $\frac{3}{4}$ in. thick, though sheets used in floor construction of this building are $\frac{1}{2}$ in. thick. This form material is oil-treated at the factory.

The large size of the plywood sheets and their light weight have the effect of reducing the labor cost on the form work. The smooth surface of the form results in a correspondingly smooth surface on the finished concrete, thereby eliminating the necessity of plastering. All of these wall surfaces and similar exposed concrete work in this building will be painted or otherwise decorated directly on the concrete, plastering being eliminated.

John Griffiths & Son Company, of Chicago, are the general contractors on the Chicago post office building, and Graham, Anderson, Probst & White, of the same city, are the architects.

EDITORIAL

Push Relief Act Construction

THE Federal Relief Act provides for allotments for federal public works and loans to states, municipalities and other forms of local government and to certain private corporations a total of $2,122,000,000 for construction and for relief and relief work. This in in addition to the opportunities in the home building field that will develop as a result of the new federal Home Loan Bank Law—an entirely separate law.

Details on how the different types of loans are to be made and repaid are contained in the law. For the present all applications for loans for relief, relief work and self-liquidating projects under this Act are to be made direct to the Reconstruction Finance Corporation (R. F. C.), Washington, D. C. Applications may be made in letter form, and after being certified by the governor of the state may be sent direct to Washington.

The kinds of construction and the amounts available for each, under the law, are summarized on the cover page and elsewhere in this issue.

To obtain the greatest benefit from this Act, local communities must exercise speed, both in making loans and in getting construction started. This is because (1) the amount of money available is limited. Already many applications for loans have been made, and at the time the law was signed applications for about 340 million dollars in loans had been filed. Communities which file their applications early are more likely to obtain the funds needed; (2) the time during which loans can be made is limited; and (3) in order to obtain federal loans, much of the construction authorized by the new law must be completed within a comparatively short time. Specifically, the Act provides that:

I—Loans for relief and relief work must be made within two years from the date of enactment of the law.

II—Loans for self-liquidating projects must be made before January 23, 1934.

III—Amounts available for federal-aid highways can be used only on construction performed before July 1, 1933.

Therefore, to make more sure that they will benefit from the new law, communities should speedily select the local projects that are needed and that qualify for loans under this Act, should lose no time in preparing applications for loans and getting them certified by the governor, and then should mail or deliver them promptly to the Reconstruction Finance Corporation, Washington, D. C.

Who Will Accept This Leadership?

MUCH is heard nowadays about the great advantages presented to the construction industry in the Federal Relief Act—and without question those advantages are real.

There are other opportunities, however, in the field of private construction and in public works not coming under the Relief Act, which architects and engineers are in a position to promote.

Industrial and mercantile buildings long deferred can not be deferred much longer. Needed street pavements must soon replace old pavements that are in a deplorable condition. Other municipal, county and state public construction can now be built at prices which may not again prevail for a decade, and therefore at an ultimate saving to the taxpayer.

Enterprising architects and engineers, aided by contractors and material people, can do much toward convincing public officials and private owners that it is poor business to wait until everybody is in the market for new construction. They can help in the task of swinging public sentiment around to the proper attitude toward a resumption of normal public works construction.

Other forces have recently come to the aid of the construction industry. The Federal Relief Act and the Home Loan Bank Act will relieve the credit situation in considerable measure. Commodity and security prices are rising, and fear has given way to confidence. Wherever one may turn, better sentiment prevails.

Finally, a new aid has appeared which many will recognize as a powerful force in the development of renewed activity in the construction industry. This new aid is seen in the resumption of advertising by the Portland Cement Association. After a silence of fifteen months this powerful organization is resuming its campaign of educational advertising, thereby adding to the growing accumulation of confidence in the construction industry in particular and in business improvement in general.

Leaders of the construction industry know the value of this aid from the Portland Cement Association. They should not fail to take full advantage of the straighter thinking which this advertising campaign will help to develop, nor should they hesitate to call on this organization for help in the promotion of individual construction projects.

A great chance is here presented for the assumption of leadership. Will the men of the construction industry accept this greater leadership?

PROGRESS—In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

Finds Advantage in Small Reinforcing Bars

THOMAS D. MYLREA, professor of building construction, Carnegie Institute of Technology, Pittsburgh, Penna., is conducting tests to determine the advantages of employing a greater number of smaller bars in the longitudinal reinforcement of concrete beams.

The principle, applied for the first time in July of this year in a test of a full-size beam, consists of using as many as 20 small bars in a beam where 5 large bars would ordinarily be used. The bars were anchored to prevent slipping. Sharp bends were avoided, the bars having been arranged in gradual curves within the beam.

The load test indicated greater strength than where ordinary methods of reinforcing are employed.

Try Concrete Slabs as Mulch for Garden Crops

PRECAST cinder concrete slabs 9 to 12 in. wide, 2 in. thick and of various lengths are being tried out as "mulch" in the growing of vegetables and small fruit at the government experimental farm at Arlington, Va. Continuous spaces 1½ in. wide are left between the slabs where the plant rows occur.

These experiments are an extension of the paper mulch experiments of a few years ago. The concrete slabs control weeds and conserve moisture, and through absorption of the sun's heat they warm up the ground earlier in the spring than under ordinary conditions.

Plants have grown as well with this slab pavement as when under ordinary cultivation.

Inspection Tour of Laboratories for Testing Cement

IT IS planned that the Cement Reference Laboratory, a joint project of the government and Committee C-1, American Society for Testing Materials, will at an early date start a third inspection tour among cement testing laboratories. At present these field inspections are made without charge. Those laboratories which desire such inspection should address their requests to the Cement Reference Laboratory at the Bureau of Standards, Department of Commerce, Washington, D. C.

The itineraries of the inspectors will be planned so as to avoid needless travel. Through most localities an inspector will pass only once during the next two years, and, therefore, applications for inspections should be filed promptly. Laboratories affected by the ruling of the Bureau of Public Roads, or requirements of other offices, necessitating Reference Laboratory inspections at certain intervals, should particularly give their attention to this matter, since this tour will in general provide only one inspection for a laboratory up to about April, 1934.

The tolerances for cement testing equipment are contained in the Standard Methods of Testing Cement, A. S. T. M. Serial C77-30. Recently proposed revisions of that standard add a few tolerances and also change some of the existing tolerances.

Freezing and Thawing Test Procedure

A PROPOSED method of testing concrete and concrete aggregates by freezing and thawing, printed as an appendix to the report of Committee C-9 on Concrete and Concrete Aggregates, was presented at the 1932 annual meeting of the American Society for Testing Materials.

The proposed method was presented at the annual meeting because of the importance of the subject and with the hope of drawing out constructive criticisms which will be of aid to the subcommittee having the work in charge.

Criticisms and suggestions should be sent to R. R. Litehiser, chief engineer, bureau of tests, Ohio State Highway Department, Columbus, Ohio, who is secretary of Committee C-9.

Reinforcing Bars of Foreign Origin to Be Marked

REINFORCING bars of foreign manufacture must be marked to indicate the country of origin, in compliance with a decision by the federal tariff commissioner which became effective on July 14, 1932.

The order was issued on the basis of a provision in the tariff law which requires imported articles to be marked to indicate the country of origin. It is believed that the decision will render more difficult the practice of substituting foreign-made bars on contracts where domestic steel bars are specified.

Cast Stone in Remodeled Store Fronts

THE use of cast stone in remodeling store fronts is illustrated in a series of plates issued by the Cast Stone Institute, 33 W. Grand Ave., Chicago, Ill. Additional plates are under preparation, including data sheets on architectural and construction details, specifications, and technical information which will be of interest and help to architects.

Non-members of the Cast Stone Institute may obtain copies of these plates, printed on 8½ by 11-in. sheets, at $2 per hundred copies.

Co-ordination of Basic Principles of Concrete Mixtures

Fifth Article Continues Study of Research in Design of Concrete Mixtures—Modification of Methods

V—Needed Laws of Mixtures and Known Fundamentals (Continued)

By JOSEPH A. KITTS
Consulting Concrete Technologist, San Francisco, Calif.

THIS installment continues the discussion of the needed laws of mixtures, and, in particular, the discussion of mixture research which appeared in the August issue.

Henby's Equation of Strength

W. H. Henby, in studying the relative strengths of various mixtures of broken stone and cinder concretes, found an equation of strength in the straight line form

$$S = A - B\,(a/c) \quad . \quad . \quad . \quad . \quad (12)$$

in which S is the compressive strength at a given age, a and c are the volumes of aggregate and cement, respectively, in the mix, and A and B are constants.[*] The values of A and B were shown to vary with the character of the aggregates employed. (See *Proceedings* of Association of Engineering Societies, Sept., 1900.)

Thacher's Equation of Strength

Edwin Thacher deduced formulas of strength, from tests made by George A. Kimball at Watertown Arsenal in 1899, in the same straight line form as that of Henby, but based on the sand-cement instead of the aggregate-cement ratio. (See page 192, Concrete and Reinforced Concrete Construction, by Homer A. Reid, 1907.) His equation is

$$S = A' - B'\,(s/c) \quad . \quad . \quad . \quad . \quad (13)$$

in which S is the compressive strength, s and c are the volumes of sand and cement, respectively, and A' and B' are shown as constants for a given age.

Henby's equation also applies to Kimball's tests. For example, Thacher's equation for concrete one month old is $S = 3100 - 350s/c$, and the corresponding Henby equation is $S = 3100 - 117a/c$.

The author finds that both Thacher's and Henby's equations are closely true (at a given age and for a given cement and aggregate) for mixtures of uniform consistency, slump, or flow, with cement contents varying within practical limits. For a given maximum size of aggregate and consistency of mix the values of A and B vary with the quality of cement and aggregate. For a given quality of cement and aggregate the values of A and B vary with maximum size of the aggregate and with consistency, slump or flow of the concrete.

The author's equations for these conditions are

$$S = M/Na/c \quad . \quad . \quad . \quad . \quad . \quad (14)$$

$$\text{or } \log S = \log M - (a/c)\log N = M' - N'a/c \quad . \quad (14a)$$

$$\text{and } S = P/Qs/c \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (15)$$

$$\text{or } \log S = \log P - (s/c)\log Q = P' - Q's/c \quad . \quad . \quad (15a)$$

Equations 12, 13, 14, and 15 are more uniformly correct where s, a, and c are by absolute volume.

The new information brought out by the Thacher equation is that the sand-cement ratio is quite as important as the aggregate-cement ratio, or, that the strength of the concrete depends upon the strength of the mortar.

These equations do not satisfy any of the required laws specified in Part 3 (July, 1932, issue of CONCRETE, pages 9-11). They involve two unknowns, the volumes of aggregate and cement, and therefore are incomplete as a basis of proportioning. However, as there is a law of strength based on the concentration of cement in the aggregate, it follows that there is a law of strength, for concentration of cement in a unit of concrete, dependent, similarly, on the maximum size of aggregate and on slump, for given quality of cement and aggregate.

The "Fuller Curve" of Grading

Wm. B. Fuller and Sanford E. Thompson made an extended series of tests, at Jerome Park Reservoir, N. Y., in 1903 and 1904, on the density and strength of different mixtures, and determined curves for grading two, three, four or more aggregates with reference to screen size analyses of the individual aggregates. The method of procedure is given in full in a paper on "The Laws of Proportioning Concrete," *Transactions*, American Society of Civil Engineers, Vol. LIX, page 67, 1907; also in Concrete, Plain and Reinforced, by Taylor and Thompson, Chapter XI and Appendix IV, 1909.

Three curves are presented, namely: (1) Parabolic Grading, (2) Maximum Density Grading, and (3) Practical Grading.

The Parabolic Grading may be expressed by the equation

$$p = \sqrt{d/D} \quad . \quad . \quad . \quad . \quad . \quad . \quad (16)$$

in which p is the proportion of the whole aggregate passing any sieve opening of d diameter, and D is the maximum size of the aggregate. The curve found to give the maximum density and strength for a given cement content, the "ideal" or maximum density grading, is a combination of an ellipse in the fine sizes and a straight line for the remainder, the axes of the ellipse being less for well rounded aggregates. In practice it was found necessary to use more sand than the laboratory tests indicated for the "ideal" or maximum density curves; the axes of the ellipse were therefore increased, resulting in the "practical" or optimum density gradings. These gradings closely approximate a parabola, Equation 16, and may be more nearly expressed by the equation

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[*] The notation used here applies only to the immediate subject.

$$p = (d/D)n \quad . \quad . \quad . \quad . \quad . \quad . \quad (17)$$

or $\log p = n\,(\log d - \log D)$ . . . . (17a)

in which n is approximately 0.5 and varies with the coarseness of grading.

Laws Indicated by Fuller-Thompson Conclusions

The laws of mixtures indicated by the tests at Jerome Park Reservoir, revising the Fuller-Thompson conclusions but slightly, are as follows (for a given cement content, similar grading of aggregate and given consistency of mix, unless otherwise designated):

1. The largest maximum size of aggregate makes the densest and strongest concrete.

2. Aggregates in which particles have been specially graded in sizes so as to give, when water and cement are added, a mixture of greatest density, produce concrete of higher strength than mixtures of the same cement content and consistency in which the aggregates have not been so graded.

3. The strength and the density of concrete are affected but slightly, if at all, by decreasing the quantity of the medium size stone and increasing the quantity of the coarsest stone. An excess of stone of medium size, on the other hand, decreases the density and the strength of the concrete.

4. Strength and density of concrete are affected by variations in diameter of sand particles more than by variation in diameter of stone particles.

5. An excess of fine or medium sand decreases the density and the strength of the concrete, as does also a deficiency of fine grains in a lean concrete.

6. The substitution of cement for fine sand increases the strength of the concrete without affecting the density.

7. Concrete of maximum density is obtained from a relatively coarse grading of aggregate and lacks workability. In practice a larger proportion of sand is required than that for maximum-density concrete.

8. It follows from the foregoing that the correct proportioning of concrete for strength consists in finding, with any cement content, a concrete mixture of *optimum* or highest practical density, and increasing or decreasing the cement by substituting it for the fine sand, or vice versa.

9. The best mixture of cement and aggregate has a mechanical analysis curve approximating a parabola, or a combination of a curve approaching an ellipse for the sand portion and a tangent straight line for the stone portion.

10. The best curve is slightly different for different materials. Well rounded gravel and sand, for example, pack closer than stone and screenings, and therefore require less of the finer particles.

11. The form of the best analysis curve for any given material is nearly the same for all maximum sizes of the aggregate.

12. The permeability or flow of water through concrete decreases as the cement content is increased.

13. The permeability is less as the maximum size of the aggregate or the density of the concrete is greater.

The Fuller-Thompson conclusions have not been disproved in any material point. The grading curve is practically and substantially correct for absolute volumes of the various sizes of particles; that is, p in Equation 17 should be the proportion of a given size particle by absolute volume.

The Fuller-Thompson method of proportioning a succession of screen sizes of aggregates, from fine to coarse, to a definite curve producing concrete of optimum density for a given cement content, is an outstanding development in the principles of mix structure. It has been employed, in the United States and abroad, perhaps more than any other scientific method. It advanced from the work of Feret by establishing a grading curve.

The principle of use of three or more size separations of aggregates and of proportioning the mix to fit the actual grading of the individual aggregates, instead of requiring the aggregate producer to supply a grading of aggregate to fit a predetermined arbitrary mix, is an important one in modern concrete technology. The principle of reducing the sand content with increase of cement content has since been well established as scientifically correct. The Fuller-Thompson grading is the first well developed concept of the proper structure of particle solids in the mixture.

Modifications of Fuller-Thompson Method

The Fuller-Thompson method required modifications to fit into the essential processes of today. It lacks a basis of cement and water contents for a given maximum size of aggregate and strength and slump of concrete. The cut-and-try graphical method of determining proportions of aggregates is slow and tedious; an expeditious and accurate algebraic method is essential. The use of weight, instead of absolute volume, as the basic measure of the ingredients, is inaccurate. The use of square hole sieves in the larger sizes is a questionable precedent. The sieve hole sizes employed do not recognize the importance of a uniform ratio as instituted by Rittinger in 1867 for testing of ores (see P. R. von Rittinger, "Aufbereitungskunde," 1867, page 222). Subsequent developments in sieve analysis and concrete physics provide the essential modifications.

The Fuller-Thompson grading provides a basis for laws of mixtures meeting our Requirements (4) and (5), as given in Part 4, in the August issue, pages 10 to 12.

Taylor and Thompson Equations

Frederick W. Taylor and Sanford E. Thompson derived an equation of strength from tests made by C. Candlot in France, and from those by several other authorities, at Watertown Arsenal, U. S. A. (see page 356, Concrete, Plain and Reinforced, Taylor and Thompson, 1909). Their equation is as follows:

$$S = M\left(\frac{c}{1 + c - (s + g)} - 0.1\right) \quad . \quad . \quad (18)$$

in which S is the compressive strength at a given age; c, s and g are the absolute volumes of cement, sand and stone, respectively, in a unit volume of concrete; and M is a coefficient "constant for all proportions of the same material mixed and stored under similar conditions, but varying with the texture of the coarse aggregate and the age of the specimen."

M may also be expected to vary with consistency, slump or flow of the mix, and with maximum aggregate size.

The item of special interest in this equation is that it is based on absolute volume relations. It involves three unknowns, c, s and g, and is therefore incomplete in itself as a basis of proportioning.

Taylor and Thompson also derived formulas for quantities of materials in unit volumes of concrete of various proportions. The basis of calculation is the absolute volume as instituted by Feret.

Withey's Tests of Mortars

Prof. M. O. Withey, assisted by A. Ludberg, E. B. Nelson, C. M. Osterheld, E. J. Paulus, and H. E. Pulver, at the University of Wisconsin, 1910-1913, made comprehensive tests of the physical characteristics of some fifteen fine aggregates of different characters, from Wisconsin sources, and also made extensive tests and analyses of mortars therefrom, and derived equations for both the compressive and the tensile strengths of the mortars. (See *Proceedings*, American Society for Testing Materials, 1913, pages 834-857.)

The equations for compressive strengths are

$$S = J\left[\frac{c}{1-(c+s)} - 0.19\right] \quad . \quad . \quad . \quad (19)$$

and

$$S = K\left[\left(\frac{c}{1-s}\right)2 - 0.012\right] \quad . \quad . \quad . \quad . \quad (20)$$

in which S is the compressive strength, c and s are the absolute volumes of sand and cement, respectively, and J and K are constants for a given quality of cement, consistency of mix and age of concrete.

These equations are based on and similar to those of Feret. The equations for tensile strength are similar, thus indicating that the laws of Feret have a wider range of application than to compressive strength alone.

"Yield" of mortar was determined by dividing the volume of mortar by the compacted bulk volume of the dry aggregate. Attention should be directed to the wide variation in yield, based on the dry compacted bulk volume, in comparison with that on the basis of the absolute volumes as instituted by Feret in 1892.

The characteristic form of the graph of compressive strength with reference to varying cement contents, as shown by these tests, points to a basis for our Requirement (1),—the law of the cement content for a given maximum size of aggregate and strength and consistency of concrete.

(To Be Continued)

Home Improvement Activity Continues Throughout the Country

Home improvement, through modernization, is continuing to arouse interest throughout the country, according to the Home Modernizing Committee of the Department of Commerce. Betterment of local labor conditions and stimulation of local business is indicated.

Reports received by the committee from sixty-two cities show that since January 1 approximately $44,600,000 has been pledged for property repair and improvement. Campaigns have been most numerous in thickly populated districts of the East and the Middle West, although individual cities of the far West have reported highly successful results and large amounts of money expended.

"The purpose of the National Committee on Reconditioning, Remodeling, and Modernization is to accelerate the demand for men and materials by stimulating repair and improvement of commercial, residential, and industrial structures. It is concerned with the welfare of the men and women who live in buildings, work in buildings, repair buildings, invest in buildings, and produce the materials for buildings," according to Fred W. Feiker, who is chairman of the committee.

New Officers and Committee Heads of A. S. T. M.

In addition to the changes in the executive officers of the American Society for Testing Materials, some changes were made among the chairmen and secretaries of committees, during the recent annual meeting.

The executive officers now include the new president, who is Cloyd M. Chapman, consulting engineer, New York City; vice-president, William H. Bassett, metallurgical manager of the American Brass Co.; and the executive committee, including H. A. Gardner, chemical engineer, Washington, D. C.; J. O. Leech, assistant metallurgical engineer, Carnegie Steel Co., Pittsburgh, Pa.; J. T. MacKenzie, chief chemist, American Cast Iron Pipe Co.; J. C. Ramage, engineer of tests, Southern Railway, Alexandria, Va.; and H. S. Vassar, laboratory engineer, Public Service Electric and Gas Co., Irvington, N. J.

Following are the present officers of committees dealing with problems pertaining to cement and concrete:

Committee C-1 on Cement.—Chairman, P. H. Bates, chief of clay and silicate products division, U. S. Bureau of Standards, Washington, D. C.; secretary, Geoff. A. Saeger, consulting chemical engineer, University City, Mo.

Committee C-5 on Fire Tests of Materials of Construction.—Chairman, Rudolph P. Miller, consulting engineer, New York City; secretary, Fitzhugh Taylor, protection engineer, Underwriters' Laboratories, Chicago, Ill.

Committee C-6 on Drain Tile.—Chairman, Anson Marston, professor of engineering, Iowa State College, Ames, Iowa; secretary, W. J. Schlick, drainage engineer, Iowa State College, Ames, Iowa.

Committee C-9 on Concrete and Concrete Aggregates.—Chairman, R. W. Crum, director, Highway Research Board, Washington, D. C.; secretary, R. R. Litehiser, chief engineer, bureau of tests, Ohio State Highway Department, Columbus, Ohio.

Committee C-10 on Hollow Masonry Building Units.—Chairman, D. E. Parsons, chief, masonry construction section, U. S. Bureau of Standards, Washington, D. C.; secretary, F. E. Emery, Structural Clay Tile Association.

Committee C-12 on Mortars for Unit Masonry.—Chairman, R. E. Davis, professor of civil engineering, University of California, Berkeley, Calif.; secretary, F. Leo Smith, Technical Secretary, The American Institute of Architects, New York City.

Officers of committees are appointed for a term of two years.

Operating a Transit Mixer Plant in Detroit

By **LOUIS CHARRON**
Concrete Engineer, Detroit, Mich.

Required Proportions Standardized Through Tabulation of Previous Experience — Mixing Practice and Job Records — Prevailing Prices Are Too Low

IN the writer's capacity as engineer for a ready-mixed concrete company, operating in Detroit and using transit mixer equipment, he has gained information that should be of value to other engineers. This information has been acquired through the technical operations involved in designing the mixtures, and by following the trucks on errands concerned with the settling of disputes and helping contractors to save time and trouble.

Required Proportions Standardized

All the concrete supplied by this company, unless governed by a specified mix, is proportioned in accordance with a list of designed mixtures made up in advance and based on previous experience with the materials used. They use one sand having a fineness modulus of 3.00, and pit pebbles in separate piles ranging in size from ¼ to 2 in. Bulk cement is used exclusively.

This plant is now able, because of the equipment employed and the knowledge gained about the materials used, to weigh out any desired combination of materials that will produce one cubic yard of concrete of a given strength. This can not be accomplished as rapidly as it should, because the scales are on different bins and are not closely grouped.

Keeping Job Records

When a transit mixer is sent out with a load, the driver is given a ticket in duplicate on which the designed strength is marked. The total amount of water added to the batch is also marked on the ticket. The original ticket is given to the contractor and the duplicate is retained by the driver and turned in at the office of the ready-mixed concrete plant as a part of the job record. If any water was added at the job at the time the load of concrete was delivered, the amount so added is indicated on the duplicate ticket.

All Materials in Mixer

The general practice is to place all materials—water and cement included—into the mixer at the plant, and the driver is given instructions as to where he is to start the mixer. This procedure is, of course, varied in cases where the specifications call for a different method.

The usual adjustments are made to allow for bulking and moisture content in the aggregates, this detail being handled by the plant operator.

Deliver 60 Cu. Yd. Per Hour

Good organization and ample equipment has enabled this ready-mixed concrete plant to deliver as much as 60 cu. yd. of concrete per hour.

Competition from several newer ready-mixed concrete companies, combined with the low volume of construction of the period, has had a detrimental effect on prices, which in June (1932) ranged from $4.00 to $4.25 per cu. yd. Obviously, under such conditions it is difficult to operate with profit.

The transit mixers used by this ready-mixed concrete manufacturer are of Jaeger manufacture.

~ PERSONALS ~

W. G. O'Bryan, who in co-operation with his father, H. R. O'Bryan, developed the "Bubblestone" method of producing light-weight concrete by an aerating process, passed away on June 12, as the result of an automobile accident which occurred two months prior to that time.

H. R. O'Bryan, who had expected to continue the development work which his son had under way, likewise passed away on July 10, at his home in Seaside, Calif., according to a letter received from his son-in-law, Milo W. Bean, 5815 Presley Way, Oakland, Calif.

Eugene F. Olsen has retired from the vice-presidency of the Besser Manufacturing Co. His stock in the company has been purchased by Jesse H. Besser. The firm's real estate in Adrian, formerly owned by the Consolidated Concrete Machinery Co., with which the Besser company was merged last year, is now owned by Mr. Olsen.

Together with the real estate, Mr. Olsen acquired possession of the Stearns Manufacturing Co., formerly a subsidiary of the Consolidated company, and will engage, at Adrian, in the manufacture of farm lighting plants and other products.

C. D. Woods, formerly with the cement products bureau of the Portland Cement Association, and more recently with the Sika Corp., has obtained an interest in the newly organized Concrete Restoration Co., 205 W. Wacker Drive, Chicago. This company will do contracting work on concrete repair, waterproofing, industrial floors and floor treatments, and related work.

M. H. Marks, concrete tile manufacturer of Edna, Kansas, passed away on June 22, after a 6 weeks' illness. He had been a resident there for fifty years.

S. P. Dinsmoor, 89, who devoted thirty-one years to the construction of a concrete Garden of Eden in the yard of his home at Lucas, Kansas, died there on July 21.

HOW TO DO IT

✦ Questions and Answers ✦
Consultation and Comment

A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

Efflorescence on Colored Concrete Floor Tile

Kindly let us know some method or means whereby the efflorescence or scum appearing on the surface of pressed cement tiles can be prevented. As you may be aware, this efflorescence is caused by curing the tiles in water.

Please indicate also what you consider the best method of removing efflorescence that has already been formed.—Pharoah, Bombay, India.

You are doubtless correct in your conclusion that the curing of the tile under water is the cause of the efflorescence, even though this is among the best methods of curing. During the immersion the water enters all void spaces in the tile, however small, and dissolves the salts. Then, when the tile is removed from the water, some of the entrapped water runs out and evaporates on the surface, leaving the salts as grayish-white deposits. Here the trouble may be avoided or greatly lessened, first, by proportioning the mixture so as to obtain greater density; second, by using a water-repellent integral admixture in the concrete or mortar; and third, some brands of cement may give less trouble than others, and this suggests the advisability of trying out the various brands available in your city.

Where efflorescence has formed it may be removed by wetting the surface and then applying a dilute solution of muriatic acid (1 part of concentrated acid to 10 parts of water). The surface must be washed thoroughly with clean water after the acid treatment.

Another method for removing efflorescence is to wash the surface with a solution of equal parts of linseed oil and kerosene, rubbing it vigorously into the surface. This treatment also improves the wearing qualities of the surface by filling the pores, and it brings out the color more uniformly. It is frequently applied to colored concrete surfaces for these reasons only.

Aggregates for Durable Wearing Surface

What aggregates and proportions are considered to be most effective in producing a durable wearing surface on concrete floors?—W. G. H., Philadelphia, Penna.

Aggregates having the qualities of toughness and hardness should be selected. Trap rock of a dense, fine grained and interlocking crystalline structure is an excellent aggregate for severe service. Hard, fine grained granites and quartzites are also suitable. For floors of a decorative nature, or where the duty imposed is not severe, aggregates of less hardness may be used. Elongated or thin plate-like fragments should never be used. All aggregates should be clean, free from dust or highly weathered fragments, and should consist of particles which will not alter in physical or chemical nature in the presence of moisture. Sand should range from 1/16 to ¼ in. in size, with not more than 5 per cent passing a 100-mesh sieve, and not more than 10 per cent passing a 50-mesh sieve. Coarse aggregate should be well graded pea gravel or crushed stone, particles ranging in size from ¼ to ⅜ in.—that is, all material passing a ½-in. sieve.

The water should be carefully controlled so that not more than 4½ to 5 gal. of water per sack of cement are used. Moisture in the aggregates should be carefully determined and this amount subtracted from the mixing water. Experience has shown that with the use of properly graded aggregates, the proportions of 1:1:1½ to 1:1:2 will give satisfactory results when mixed with not more than 4½ to 5 gal. of water. It is recommended that curing be continued over a period of at least a week to 10 days. Proper curing will help produce a surface that is hard, dense and strong.

Concrete Made with Haydite Aggregate

We are informed that a bulletin published by the University of Illinois contains the latest test data on concrete made with haydite as the aggregate. Kindly let us know where that bulletin may be obtained.—B. S. C., Bristol, England.

A complete report on the results of the tests to which you refer was published in October, 1931, by the University of Illinois Engineering Experiment Station, Urbana, Illinois, as Bulletin No. 237, and under the title "Tests of Plain and Reinforced Concrete Made with Haydite Aggregate."

Stains for Hardened Concrete Floors

Recently I have seen references to the use of acid to stain concrete floors to obtain brownish or greenish effects. Can you tell me where such acids may be secured? I do not want a mineral color mixture, but a stain that can be applied to concrete floors after the concrete has hardened.—J. G. E., Milwaukee, Wis.

Several manufacturers—a list is being forwarded to you—supply a chemical that stains hardened concrete. Leathery brown effects, various shades of green and a number of other tints may be obtained, depending in part on the number of applications of the chemical.

New Books and Pamphlets

Permeability of Gravel Concrete Research Project

Permeability of Gravel Concrete. By Paul T. Norton, Jr., and Dan H. Pletta. Reprinted as a separate pamphlet by the American Concrete Institute, 641 New Center Building, Detroit, Mich. Paper cover, 40 pages, 6 by 9 in., numerous diagrams and tables.

The research project reported in this bulletin was conducted throughout a period of three years in the mechanics department of the University of Wisconsin. The investigation included the study of the relationship between permeability and the water-cement ratio, and also the relation between permeability and other properties such as strength, consistency, absorption, cement-voids ratio and grading of aggregates.

Tests of Plain and Reinforced Haydite Concrete

Tests of Plain and Reinforced Concrete Made with Haydite Aggregates. By Frank E. Richart and Vernon P. Jensen. Published by the University of Illinois, Urbana, Illinois, as Bulletin No. 237 of the engineering experiment station. Paper cover, 82 pages, 6 by 9 in.; halftone illustrations, diagrams and tables. Price 45 cents.

The tests described in this bulletin were conducted in co-operation with the Western Brick Company, Danville, Illinois, manufacturers of haydite.

The investigation was divided into two groups of tests. The first included tests concerned with the properties of haydite aggregate itself, while the second group comprised tests to determine the properties of concrete made with haydite aggregate.

Handbook Shows Details of Form Work

Contractors' Handbook, with the secondary title of Concrete Form Work, is the name of a useful 112-page handbook recently issued by the Marion Malleable Iron Works, Marion, Indiana. Price 25 cents.

In addition to a number of details of concrete forms in building construction, this handbook contains tables of quantities for concrete work, instructions for bending reinforcing steel, tables of weights and measures, data on the design and quantities for concrete silos, and numerous mathematical tables.

Tests of 20-Year-Old Concrete

Some Long-Time Tests of Concrete. By M. O. Withey. Reprinted as a separate pamphlet by the American Concrete Institute, 641 New Center Building, Detroit, Mich. Paper cover, 36 pages, 6 by 9 in. Tables and diagrams.

This report covers a series of tests begun in 1910 at the University of Wisconsin. Results of crushing tests after 20 years of storage are given. The program has been planned to include the breaking of specimens having ages up to 50 years, and kept under various storage conditions.

‹ ORGANIZATIONS ›

American Association of State Highway Officials; W. C. Markham, Executive Secretary, 1222-24 National Press Building, Washington, D. C.

American Concrete Institute; Harvey Whipple, Secretary, 641 New Center Building, Detroit, Mich. Twenty-ninth annual convention, Feb. 20-23, Chicago, Ill.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 West Grand Ave., Chicago.

American Road Builders' Association; Chas. Upham, Engineer-Director, National Press Building, Washington, D. C.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 West Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, 1315 Spruce St., Philadelphia, Pa.

Associated General Contractors of America; E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Cast Stone Institute; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.

Cement Institute; Luther G. McConnell, General Manager, 11 East 44th St., New York City.

Concrete Masonry Association; Jack Franklin, Secretary, 7071 Plankinton Bldg., Milwaukee, Wis.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, 333 North Michigan Ave., Chicago.

Engineering Institute of Canada; 2050 Mansfield St., Montreal, Quebec.

Joint Committee on Standard Specifications for Concrete and Reinforced Concrete; F. R. McMillan, Secretary, 33 West Grand Ave., Chicago.

National Board of Fire Underwriters; W. E. Mallalieu, General Manager, 85 John St., New York City.

National Concrete Burial Vault Association; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.

National Crushed Stone Association; J. R. Boyd, Secretary, 1735 14th Street, N. W., Washington, D. C.

National Engineering Inspection Association; B. H. Witherspoon, Secretary, P. O. Box 1115, Pittsburgh, Pa.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.

National Ready-Mixed Concrete Association; V. P. Ahearn, Secretary, 545 Munsey Building, Washington, D. C.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 545 Munsey Bldg., Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 937 Leader Bldg., Cleveland, Ohio.

National Terrazzo and Mosaic Association; U. F. Durner, Secretary, 815 West St. Paul Ave., Milwaukee, Wis.

Northwest Concrete Products Association; W. P. Hews, Secretary-Treasurer, Yakima, Wash.

Portland Cement Association; Edward J. Mehren, President; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary; Builders' Bldg., 228 N. La Salle St., Chicago, Ill.

Wire Reinforcement Institute; R. D. Bradbury, Director, National Press Bldg., Washington, D. C.

Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer, 425 East Water St., Milwaukee, Wis.

Non-Porous Aggregate Product of Centrifugalized Slag

New Light-Weight Aggregate Suitable for All Concrete Uses—Process of Manufacture

Blast-furnace slag that has been centrifugalized forms the base of the new light-weight aggregate known as Waylite and now being introduced by the Chicago Waylite Aggregate Co. of that city.

It is suitable for use in monolithic, ready-mixed or vibrated concrete, concrete products, and cast stone.

Light weight is said to be retained even when the aggregate is in contact with fluids. Its color ranges from white to light buff. Other qualities claimed for Waylite include fireproofing, insulating, acoustical, and sound deadening. It is fully and scientifically controlled throughout the manufacturing process, and is uniform in structure and quality, according to the Waylite company. It is also said to be free from organic matter.

Waylite, it is stated, differs from other types of light-weight aggregates in that it is not of porous structure. The definite action of the steam upon the molten slag prior to or almost during the period of solidification forms small cells which are said to have highest structural strength.

Cells are completely impregnated through the whole particle, and are separate from each other. In concrete-making observations it has been found that the individual particles of Waylite become completely coated with the cement paste and the numerous surface cells become filled. The entire center of the particle, however, remains a pure white in color.

From the blast-furnace the molten slag is fed to a completely enclosed centrifugally operated expelling machine where, during the period of centrifugalization but prior to solidification, the slag is impregnated, in an atmosphere of steam, with minute non-communicating cells. Expansion of the molten slag and creation of the light-weight, fireproofing, and insulating qualities result. The original intense heat of the molten slag is slowly decreased during the period of processing, leaving a product with a moisture content of but .005 per cent.

Pioneer Steel Firm Celebrates Ninetieth Anniversary

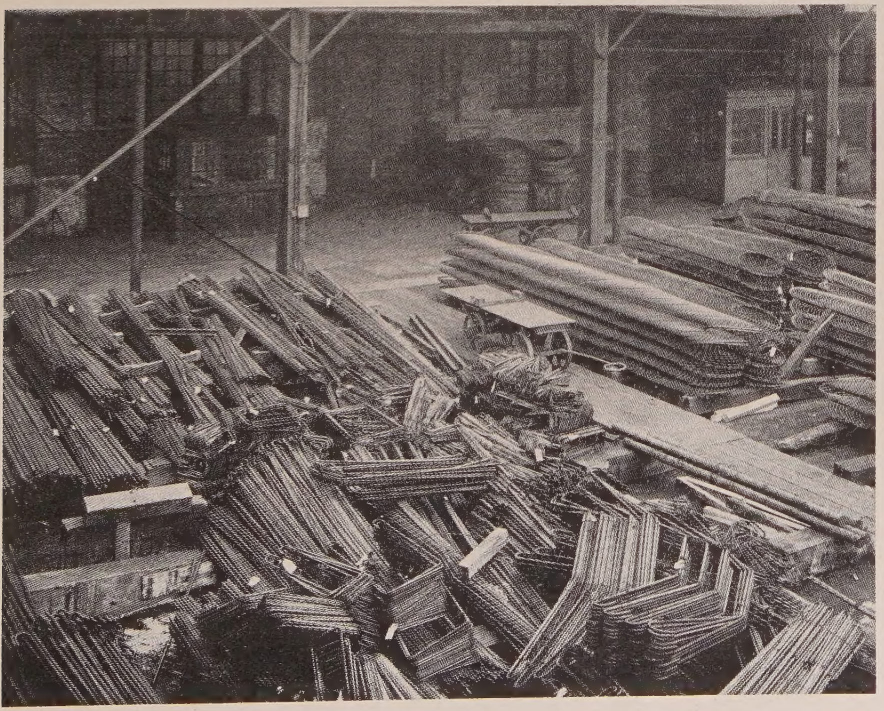
The firm of *Joseph T. Ryerson and Son, Inc.*, of Chicago, with plants in other principal cities, is celebrating its ninetieth year in the steel business. The first store was established in 1842, when Chicago was a town of barely 6,000 inhabitants.

Organized to serve users of steel products in all lines, the company entered the reinforcing bar field in 1911, building up quite a large stock of square twisted bars which were then very much in favor among engineers and contractors. Complete facilities were provided for rendering prompt service.

In later years, when the square twisted bar fell into disfavor as a result of tests conducted at the University of Illinois, a stock of deformed bars was laid in to meet the changed requirements of the building industry. At the present time, the reinforcing steel division of the company is recognized as one of the principal sources of supply in the country for all kinds of reinforcing steel and accessories used in concrete construction.

Backing up the reinforcing division are the other steel divisions of the house, enabling the contractor to secure miscellaneous steel commodities and specialties from the same source that furnishes the standard reinforcing products. It is this ability to render a complete service that places the Ryerson company in a rather unique position in the steel business.

Edward L. Ryerson, Jr., president of the company, is the grandson of the founder, Joseph Ryerson, and represents the fourth generation of the Ryerson family to become associated with the iron and steel industry in this country.



Start Publication of Weekly Housing Reports

A new weekly report service on housing, to appear under the heading of *Millar's Housing Reports*, is to start publication with the issue of September 3 from the head office in Chicago.

These reports are to be published in the belief that a real need exists for an information clearing house that will bring the gist of all main developments in housing to the attention of architects, builders, building supply people, real estate men, building and loan associations, and others concerned.

New Type of Press Service

Martin H. Kidder, for several years press agent for *Link-Belt Co.*, has recently established his own and new type of press service, with headquarters at 12238 Normal Avenue, Chicago, Illinois.

One of Mr. Kidder's clients is the Harnischfeger Corp., Milwaukee, Wis., for over 40 years manufacturers of material handling machinery and welding equipment.

A Booklet on Hoover Dam

Volume 2 of a series of booklets describing work at the Hoover dam as it progresses has been issued by *Ingersoll-Rand Co.* The building of Boulder City and the driving of the four 56-ft. tunnels which will divert the Colorado river through the walls of Black Canyon while the dam is being erected are featured in the current issue.

These booklets appear under the general title, "*The Story of the Hoover Dam*" and are obtainable at the main office of the company at New York City, or at any branch office. Volume 2 consists of 40 pages and 85 illustrations.

New Equipment and Materials

Spi-ro-loc Is New Universal Form Clamp

The Spi-ro-loc form clamp is a new device especially adapted for watertight and stainproof walls and for use wherever ties must be back from the concrete face. It is claimed to have more speed than a wedge assembly plus the fine adjustment of square cut threads.

The assembly consists of two outside rods, drilled and tapped to take an inside rod threaded at both ends. When the two outer rods and inside rod are in place in the form, the casting is slipped over the rod within one or two threads of the wale, where it is seated and given one or two turns to draw the form into line. An extra casting is applied in the usual manner to bear against the casting already in place, acting as a lock nut. In removing, the rod is backed off of the inner tie by turning the first casting.

The device is the product of the Universal Form Clamp Co., Chicago.

Pumpcrete System Introduced by Chain Belt

Pumping of concrete to the forms in quantity was introduced in America during August, when the Pumpcrete, owned by the Chain Belt Co., was used on the Thirty-fifth street viaduct at Milwaukee.

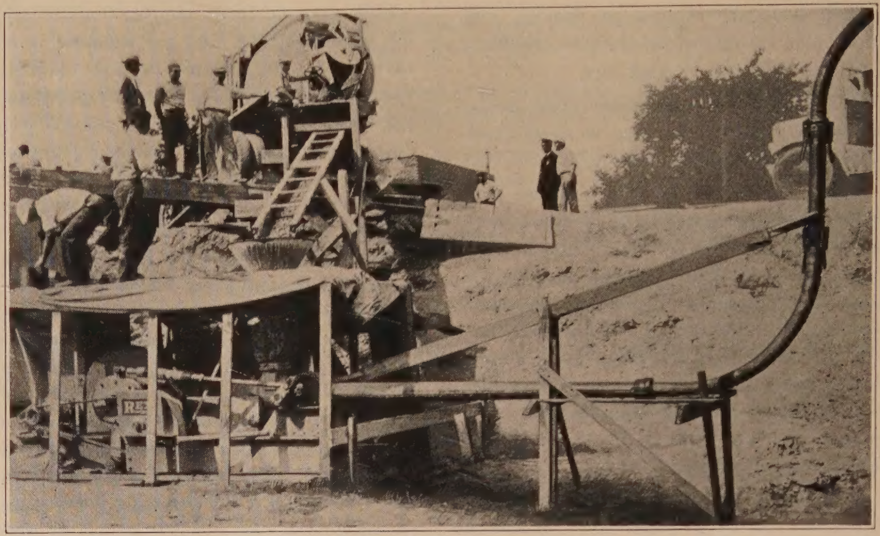
The demonstration lasted twelve hours, during which the unit handled 125 yd. of mixed concrete to forms, including 1½ hr. idle time waiting for delivery.

Pumpcrete was first developed in Europe for delivering concrete to the forms by direct pumping action. Other demonstrations are expected to be held in various parts of the country in the fall by the Chain Belt Co., who are the American manufacturers and distributors.

The pump is of the piston type, gasoline or electric motor driven, and has a capacity of 15 to 20 yd. of concrete per hour, and is portable. It will transport concrete 500 ft. horizontally, or up to 72 ft. vertically, the company states.

In the Milwaukee test, the concrete of the standard mix being used on the project was delivered in Moto-Mixers to the hopper of the pump, the gasoline motor was started and the Pumpcrete started on the test that was to run through the full working day and well into the night. The concrete, as it was delivered to the forms, was rigidly inspected, and its quality, if changed at all, was said to be somewhat improved.

Five-inch pipe was employed in the pipe line and the aggregates of relatively large size were moved through it, all day long, without a bobble. The pipe used was in 10-ft. lengths, equipped with quick couplings.



Industrial Literature

Wire Cloth Handbook

The Newark Wire Cloth Co., Newark, N. J., has just released its new general catalog *No.* 32.

It is in handbook form and contains more than 100 pages of information. Its listings include 400-mesh cloth, stainless steel wire cloth, Nichrome, testing sieves, sieve shaker, and fabrication of wire cloth parts.

Cement Conveying

The *Fuller-Kinyon* system is the subject of a new general catalog being issued in loose-leaf form by the *Fuller Co.,* Catasauqua, Pa.

The catalog embraces the handling of bulk cement for concrete mixing and batching plants, and car and barge unloading. Various installations are shown photographically.

Field Activities

Olsen Leaves Besser

Retirement of *Eugene F. Olsen* as vice-president of the Besser Manufacturing Co., purchase of his stock in the company by Jesse H. Besser and the purchase by Mr. Olsen of the company's real estate in Adrian, Mich., formerly owned by the Consolidated Concrete Machinery Co., with which the Besser company was merged last year, was announced in the latter part of July.

Mr. Olsen has acquired possession of the Stearns Mfg. Co., formerly a subsidiary of the Consolidated company, and will engage, at Adrian, in the manufacture of farm lighting plants and other products.

Cletrac Distribution, Service

The *Austin-Western Road Machinery Co.,* domestic sales organization of the *Austin Manufacturing Co.* and the *Western Wheeled Scraper Co.,* announce that they will handle the industrial sales and service of Cletrac crawler tractors in 24 states, broadly the territory covered by the midwestern, southern and southeastern states.

New K & J President

Julius F. Stone, Sr., was elected president of the *Case Crane & Kilbourne Jacobs Co.,* Columbus, Ohio, manufacturers of the "K & J" line, at a recent annual meeting of stockholders.

Mr. Stone has assumed active direction of the company, and *H. C. Hoeflich* has been elected vice-president and sales manager. The latter has been associated with the company for several years.

The K & J line includes wheelbarrows, drag scrapers, wheel scrapers, concrete carts, warehouse trucks, baggage wagons, etc. Another line also includes automatic air dump cars, quarry cars, etc.